What is claimed is:

1. A dispersion element for a laser pulse compression device adapted to compress a phase-modulated pulse, said dispersion element being based on a planar photonic crystal structure made as an one-dimensional (1D) periodic structure formed in a layer of a high index material having a predetermined thickness and refractive index n_2, the high index material layer being deposited on a substrate with refractive index n_1, at $n_2 > n_1$, the periodic structure comprising a plurality of parallel grooves having a predetermined width and depth, made in the high index layer at equal distance from each other, wherein the pulse propagates in the dispersion element perpendicularly to the grooves, and a length of the dispersion element is defined so that to provide maximum compression of the phase-modulated pulse.

2. The dispersion element as set forth in claim 1, wherein said periodic structure is covered with a protective layer made of a material with predetermined refractive index n_3 to provide mechanical strength and reduce scattering loss, where $n_3 < n_2$ by a value providing guided propagation of the pulse in single-mode operation.

3. The dispersion element as set forth in claim 1, wherein length L of the dispersion element is defined from the expression:

$$\frac{(a_0 T^2)^2}{[1+(a_0 T^2)]a_0 k''}$$

where a_0 is the phase velocity of the phase-modulated pulse, k" is the group velocity dispersion in 1D planar photonic crystal structure, T is the duration of an input pulse.

4. A dispersion element for a laser pulse compression device adapted to compress a phase-modulated pulse, said dispersion element being based on a planar photonic crystal structure made as a two-

dimensional periodic structure with predetermined period *a*, formed in a layer of a high index material having a predetermined thickness and refractive index n_2, the high index material layer being deposited on a substrate with refractive index n_1, at $n_2 > n_1$, sites of the 2D periodic structure having first holes of a predetermined equal size, forming columns, and second holes of a predetermined equal size different from that of said first holes, forming a predetermined number of adjacent columns, wherein said sizes of the said and second holes and said refractive indexes are defined so that to provide guided propagation of the phase-modulated pulse in single-mode operation along the columns of the second holes in the structure, and a length of the dispersion element is defined so that to provide maximum compression of the phase-modulated pulse.

5. The dispersion element as set forth in claim 4, wherein said 2D periodic structure is selected from a trigonal, rectangular or square periodic lattice.

6. The dispersion element as set forth in claim 4, wherein said 2D periodic structure is covered with a protective layer of a material with predetermined refractive index n_3 to render mechanical strength and reduce scattering loss.

7. The dispersion element as set forth in claim 4, wherein length L of the dispersion element is defined from the expression:

$$\frac{(a_0 T^2)^2}{[1+(a_0 T^2)]a_0 k''}$$

where a_0 is the phase velocity of the phase-modulated pulse, k" is the group velocity dispersion in 1D planar photonic crystal structure, T is the duration of an input pulse.

8. The dispersion element as set forth in claim 4, wherein the depth of the first holes at the sites of said periodic structure can be equal, less or greater than the thickness of the high index material layer.

9. The dispersion element as set forth in claim 4 or 8, wherein the depth of the second holes at the sites of said periodic structure can be less, equal or greater that the thickness of the high index layer, as well as the depth of the first holes.

10. The dispersion element as set forth in claim 4, wherein distances between centers of the second holes and centers of the nearest first holes at the periodic structure sites can differ from the period *a* of said structure.

11. The dispersion element as set forth in claim 4, wherein said first and second holes at the 2D periodic structure sites are in the shape of circular cylinders.

12. The dispersion element as set forth in claim 4, wherein said second holes form a single column in said 2D periodic structure, over which column the phase-modulated pulse accomplishes guided propagation in single-mode operation.